MOSSG

Preliminary Priorities
Provided to SM&C
By the MOSSG team
October 2014

Overview

- MOSSG presents:
  - Preliminary ***Priorities – Services***
  - Preliminary ***Priorities – Core*** Capabilities
- The ***Priorities – Services*** are what was expected from MOSSG, so we are presenting it first.
  - With “Warnings”
- The Priorities – Core are presented second.
- However, the MOSSG believes the Priorities – Core are more important and are actually prioritized over all of the Priorities – Services.

PRIORITIES - SERVICES

Warnings about “Preliminary” Priorities - Services

- The CCSDS requested that Preliminary Priorities should be delivered to SM&C to guide their work into CY15.
- The MOSSG warns that “Preliminary” priorities are dangerous because “Final” priorities may be greatly modified, after the MOSSG completes our other analyses of Mission Operations Systems approaches.
- At the current pace, in the absence of funding for additional MOSSG work, the final analysis will not be available for years.
- However, the MOSSG concedes that “Preliminary” priorities are better than no priorities at all for 2015.
- In particular, the MOSSG has within it’s range of possible options to assert that an SM&C Service Interface may not be the right option for some data types and services.
  - As with the current ISS program, it may be that some functions are best done simply with “Shared Software” or “Remote Login” or other centrally-controlled functions, rather than a Peer SOA environment.
- Final MOSSG priorities, years from now, may advocate non-SM&C approaches for some of the services on the following priority list.
- Our understanding is that SM&C did not do an “operations concept” tradeoff on what data functions or services are best served by SOA (or other) approaches. It was a given that SM&C would do all services via SOA. MOSSG is not similarly constrained.
- Result: CCSDS and SM&C embark on this work at risk. It may be successfully completed, but if analysis indicates shared software is more effective for any given service, the SM&C SOA developed for that service may never be used.
- This is more indication that SM&C should focus on core capabilities more than branching out to new services.

Context of MOSSG Work

- MOSSG recognizes that the MOSCG survey was a valuable result.
  - Excellent approach to cast a wide net for the needs of many missions
- However, the MOSSG is doing other analyses that are not yet complete.
  - “Drill down” into more detailed study of two complex missions, analyzing services and their resulting appearance in “IOAG Service Catalog 3”.
  - Overall study of operational concepts for interoperability – Validate SM&C direction with understanding of how it fits into operations.
- For “Preliminary Priorities-Services”, only the MOSCG Survey is available as a starting point.

Source Data – MOSCG Survey Results

Legend
MO Systems data exchange (CCSDS)
MO Practices (Flight Ctrl Teams)
General Questions

PRIORITY 1
Telemetry
Navigation
File Transfer
Planning – Communications Passes
File Uplink/Downlink
Archive
Realtime Commanding
Preplanned Commanding
Planning – Vehicle Systems
Command Responses
Security
Flight Control Emergency Support
Service Catalog 3

PRIORITY 2
Planning – Crew Activities (systems)
Planning – Planetary Surface
Logistics
Realtime Voice
Time Synchronization/Correlation
Planning – Crew Activities (procedures)
Realtime Video
Training – Flight Crew
Train – Ground Crew
Telerobotics
Planning – Spacecraft Systems
Command History

PRIORITY 3
Planning – Science
Antenna Management
Crew Medical
Onboard Buffer Management
Video Systems Control
Launch Processing
IOAG Coordination of Practices
Onboard Maintenance
Playback Video
Launch Operations
Playback Voice
Software Management
Flight Control - LEOP
Flight Control - LEO
Flight Control -Cruise

Step 1: Map Survey results to (future) SM&C Books

Init. Pri.	Priority In Order from MOSCG Survey	SM&C Book topic	Comments
1	Telemetry	M&C Services (in work)	Virtually complete
1	Navigation	Navigation Service	Not recognized by NAV WG
1	File Transfer	File Management	
1	Planning – Communications Passes	? CSSM?	Maybe CSSM duty instead of SM&C?
1	File Uplink/Downlink	File Management	Uses CFDP but augments w/ mgt.
1	Archive	Archive Service	
1	Realtime Commanding	M&C Services (in work)	
1	Preplanned Commanding	M&C Services (in work)	Not clear if covered by M&C now.
1	Planning – Vehicle Systems	Planning Services	
1	Command Responses	M&C (?) Should be?	Not clear if covered by M&C now.
1	Security	NEW Security Service	
2	Planning – Crew Activities (systems)	Planning Service	
2	Planning – Planetary Surface	Planning Service (?)	
2	Logistics	NEW Logistics Service	
2	Realtime Voice	NEW Voice Service (?)	
2	Time Synchronization/Correlation	Time Service	Service would require TS/C WG formation
2	Realtime Video	NEW Video Service	
2	Telerobotics	Telerobotics Service	
2	Command History	M&C (?)	Not clear if covered by M&C now.
3	Antenna Management	NEW or M&C Svc?	
3	Crew Medical	NEW Crew Medical	Unique but critical data type.
3	Onboard Buffer Management	Remote Buffer Mgt Svc.	Unclear if this is a priority at all.
3	Video Systems Control	NEW Video Service	
3	Onboard Maintenance	NEW Onboard Maintenance	Maybe part of Logistics?
3	Playback Video	NEW Video Service	
3	Playback Voice	NEW Voice Service	
3	Software Management	NEW Software Management	

Step 2 – Group sub-services and reprioritize

Init. Pri.	Priority In Order from MOSCG Survey	SM&C Book topic	Comments
1	Archive	Archive Service	
1	File Transfer	File Management	
1	File Uplink/Downlink	File Management	Uses CFDP but augments w/ mgt.
2	Command History	M&C (?)	Not clear if covered by M&C now.
1	Command Responses	M&C (?) Should be?	Not clear if covered by M&C now.
1	Telemetry	M&C Services (in work)	Virtually complete
1	Realtime Commanding	M&C Services (in work)	
1	Preplanned Commanding	M&C Services (in work)	Not clear if covered by M&C now.
1	Navigation	Navigation Service	Not recognized by NAV WG
3	Crew Medical	NEW Crew Medical	Unique but critical data type.
2	Logistics	NEW Logistics Service	
3	Onboard Maintenance	NEW Onboard Maintenance	Maybe part of Logistics?
3	Antenna Management	NEW AntMan or M&C Svc?	
1	Security	NEW Security Service	
3	Software Management	NEW Software Management	
2	Realtime Video	NEW Video Service	
3	Video Systems Control	NEW Video Service	
3	Playback Video	NEW Video Service	
3	Playback Voice	NEW Voice Service	
2	Realtime Voice	NEW Voice Service (?)	
2	Planning – Crew Activities (systems)	Planning Service	
2	Planning – Planetary Surface	Planning Service (?)	
1	Planning – Vehicle Systems	Planning Services	
1	Planning – Communications Passes	Planning Svc or CSSM?	Maybe CSSM duty instead of SM&C?
3	Onboard Buffer Management	Remote Buffer Mgt Svc.	Unclear if this is a priority at all.
2	Telerobotics	Telerobotics Service	
2	Time Synchronization/Correlation	Time Service	Service would require TS/C WG formation

SM&C Book topic	Avg Priority from Col. A
Archive Service	1
File Management	1
Navigation Service	1
NEW Security Service	1
M&C	1.2
Planning Service	1.5
NEW Logistics Service	2
Telerobotics Service	2
Time Service	2
NEW Voice Service	2.5
NEW Video Service	2.7
NEW Crew Medical	3
NEW Onboard Maintenance	3
NEW Antman or M&C Svc?	3
NEW Software Management	3
Remote Buffer Mgt Svc.	3

Final Services Priorities and Sanity Check

SM&C Book topic	Priority
Archive Service	1
File Management	1
Navigation Service	1
NEW Security Service	1
M&C	1.2
Planning Service	1.5
NEW Logistics Service	2
Telerobotics Service	2
Time Service	2
NEW Voice Service	2.5
NEW Video Service	2.7
NEW Crew Medical	3
NEW Onboard Maintenance	3
NEW Antman or M&C Svc?	3
NEW Software Management	3
Remote Buffer Mgt Svc.	3

- Many more mission facilities need remote archive access than need realtime telemetry. Therefore the Archive priority compared to M&C makes sense.
- File Management and Navigation are understandable priorities for more missions than M&C.
- Security services responses may be driven by media hype more than threats. Security controls are in place, just not in an interoperable way. A service interface for cooperative or federated security may not be such a high priority, but SM&C should begin discussions with the Security WG about potential needs for service interfaces to share identities, etc.
- Planning service position below Archive and File Management, but above Logistics and Telerobotics seems about right.
- Other lower priority services also seem about right except…
- Crew Medical has a very small mission set (only joint human missions) but it is an incredibly critical and life-critical function. It is probably prioritized too low in this list.
- Perhaps Remote/Onboard Buffer Management is not well understood, but it seems appropriate to be lowest on the list or even deleted.

PRIORITIES - CORE

General Context of Priorities-Core

- These are provided as work that needs to be done in order for agencies to realize the vision of improvements that should result from a standardized service oriented architecture, including standardized service interfaces.
- Some of this work may already be underway in CCSDS; The MOSSG doesn't have a full understanding of current SM&C activities within the working group.
- This is not intended as criticism of CCSDS, simply a statement of forward work that is needed.

Some MOSSG Observations

- The MOSSG has observed:
  - The “plug-n-play” presentation material distributed by SM&C builds expectations of minimal effort (outside of the standards) required by service providers and consumers to enable interoperability.
  - There was a large ICD-like PID (ICD equivalent) required for the JSC/DLR prototype, and extensive JSC/DLR coordination required to execute the prototype
  - In assessments of the MO Services by individuals that are external to the working group, concerns have been raised over abstract vs. concrete specifications, blue/magenta book issues, etc.
- We think these observations are related, and they indicate that even the “completed” services (M&C and underlying core standards) are not yet at full standardization maturity.
- It is more important to achieve full maturity of the existing standards as a higher priority than investing resources in new services.
  - Resources really means ***competing*** resources – for example the resources for the telerobotics service generally do not compete for the resources in in the core MO Services work.
  - The MOSSG can’t say whether other startup efforts (Planning BOF, etc.) compete with SM&C resources. CCSDS should consider this.

Some MOSSG Observations

- SM&C seems to be developing component services, not fully developed service interfaces.
- The “service interface” that is specified by the end-to-end compilation of the SM&C documents does not meet the expectations of “plug-n-play” or automated configuration.
  - Expectations are described in SM&C presentations, and in the MOSCG presentation to the IOP.
- The probable area to “augment” in the SM&C specifications is the “configuration service” in the Common Services document.
- However other new specifications may be required – Unknown.
- The augmented specifications should:
  - Move towards “automated configuration services”
  - Move towards “discovery of services” that can be genuinely exposed by a service provider, discovered by a service consumer.
  - Focus on exposing (publishing) the capabilities and characteristics of a service to an authorized subscriber (factoring in security concerns).

More discussion on the Plug-n-Play capabilities

- Some things that need to be done in order to realize the plug-n-play vision of service interfaces:
  - Service Interfaces should allow “discovery” of ***some*** material that was documented manually in the JSC-DLR “PID” (ICD).
    - Some facility-unique data (firewall rules, IP addresses) must necessarily be separately agreed to in an ICD… but not that much.
  - Service Interfaces should be built so a “client” service can be built and/or integrated by a consumer that will connect to a service provider in an automated way (implementable “blue book fashion”)
  - Current M&C service does not realize this vision.
- It may be that this is primarily or even exclusively a function of automation in the “Configuration Service”
  - A fully expanded Configuration Service may be significant enough to be a standalone blue book.
  - It *__may__* be the final blue book in the SM&C end-to-end service specifications that is needed to offset the concerns that have been raised about “abstract” and “non-blue” specifications.

Automated Configuration Services

What follows is the “vision” of the capabilities

- A Client in a control center that needs to be a data consumer can reach the programmatic interface (Web services or RESTful or JSON?) in another control center and “discover” services”.
- The developer/controller operating the client can (to the maximum extent possible) view a list of services, and for the telemetry services, he can view (for example) the parameters available.
- He can select those parameters that he needs on a display and place them on that display.
- He can then “run” that display and it will fetch the required telemetry.
- “to the maximum extent possible” means there are some vehicle-unique or program-unique things that can’t be discoverable. But it is a lot more discoverable than provided by the current SM&C service concept.

Automated Configuration Services

- "Automated" term means that it is more automated than the current SM&C architecture configuration services (discovery capabilities).
- Configuration Services is a service in the "Common Services" book.
- Right now it's basic, not automated.
- Configuration services are central to discovery capabilities in the service interface.
- Proposed recommendation to SM&C: "finish" the Configuration services, "finish" discovery of services for M&C as a higher priority than starting new application services.
- Result should be a specification that is "blueish" – An organization can build a consumer client that can connect to an existing service provider with ***minimal*** program-specific ICDs required.

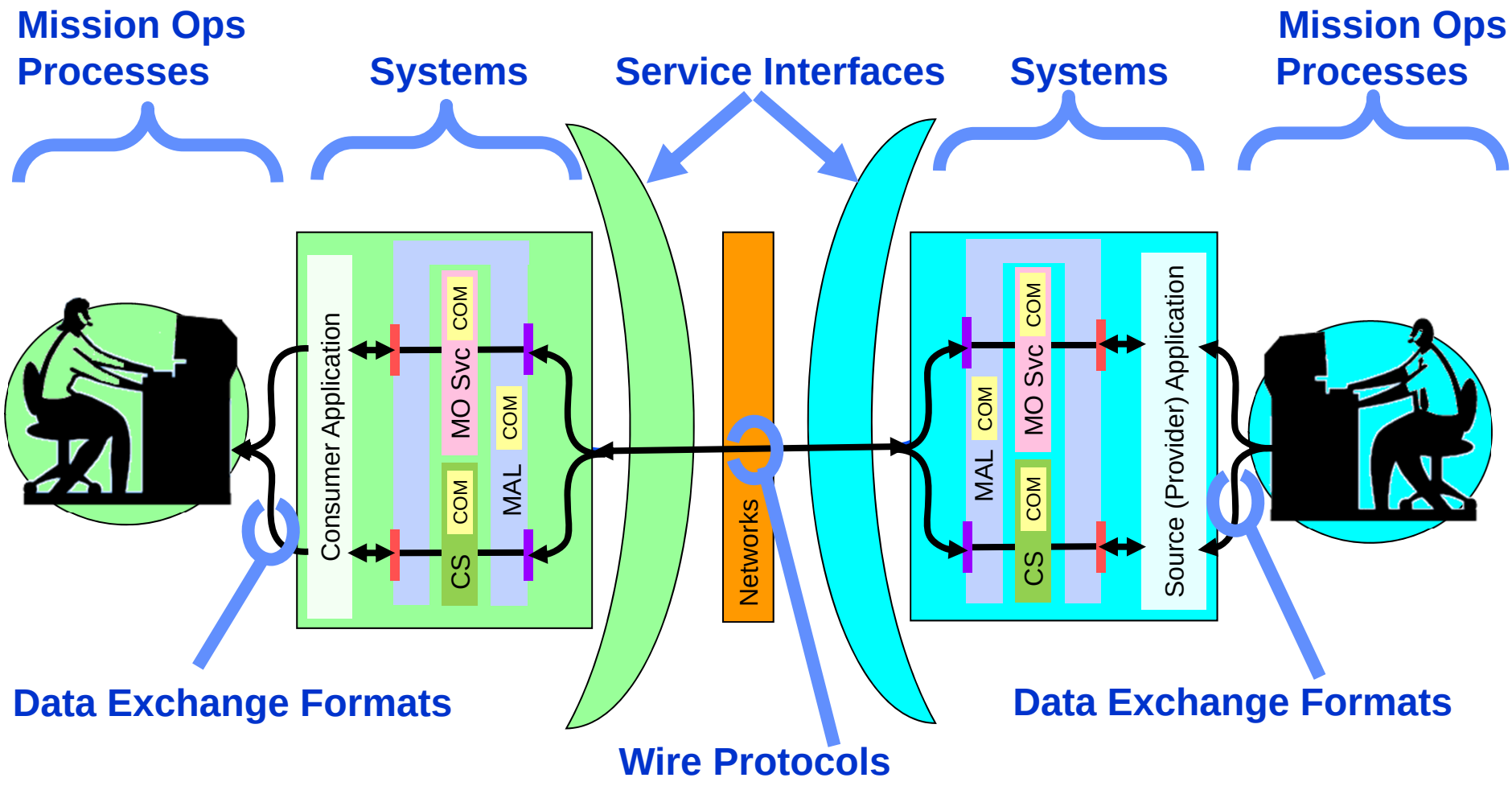
Program Scenario – where we want to get to

- A service provider already has a service interface for Telemetry that complies with the SM&C document suite.
- A new service consumer needs to develop a service interface that will connect with it to access telemetry.
- The organizations agree to use SM&C M&C Standards. Each organization studies these documents:
  - MAL, COM, M&C, etc… (SM&C: fill in the blanks?)
- Organizations develop a "PID-like ICD" which contains only the minimum necessary project/facility unique items.
  - List of functions within the MAL/COM/M&C specs which are to be implemented (assuming not all functions will be implemented - Perhaps accomplished with PICS-Proforma?)
  - List of IP addresses and agreed to secure authentication mechanisms
  - etc… (SM&C: fill in the blanks?)
- They sign the ICD and agree to the development schedule which supports the Operational Need Date.
- The service consumer organization develops the MAL, COM, M&C service interface code, etc.
  - (SM&C: fill in the blanks?)
- Develop "discovery" capability (auto config service?) and pub/sub server with discoverable service I/F
- Organizations conduct unit tests separately
- Organizations initiate and complete joint tests.
- Operational configuration is established (describe initiation of web services functions)
- Org A places service request calls to Org B and accessible services are displayed to consumer.
- Consumer selects telemetry service, selects specific parameters.
- Consumer connects service to display application and begins to stream RT TLM parameters.
- From then on, the operations teams have the ability to reconfigure set of TLM/CMD functions using discovery of services (operational configuration supersedes ICD agreements)

Program Scenario – where we think we are

- A service provider already has a service interface for Telemetry that complies with the SM&C document suite.
- A new service consumer needs to develop a service interface that will connect with it to access telemetry.
- The organizations agree to use SM&C M&C Standards. Each organization studies these documents:
  - MAL, COM, M&C, etc… (SM&C: fill in the blanks?)
- Organizations develop a "PID-like ICD" which contains:
  - Same as previous chart, plus…
  - Many more technical descriptions (layers, services, etc.)
  - Internal network architecture descriptions.
  - Encoding, XML Schema, XTCE Entity Definitions (should be discoverable)
  - Parameter definitions, Alert definitions (should be discoverable)
  - Common Model Operations, MAL data structures required for Directory Services, etc.
- They sign the ICD and agree to the development schedule which supports the Operational Need Date.
- The service consumer organization performs the same development activities as prior chart.
- Telecons and extensive coordination required outside of the necessary technical documents.
- Organizations conduct unit tests separately
- Organizations initiate and require extensive mods to complete joint tests.
- Operational configuration is established (describe initiation of web services functions)
- Org A places service request calls to Org B and begins final configuration.
- Consumer discovers more parameters are needed, initiates rework and resigning of ICD to add them.
- Consumer connects service to display application and begins to stream RT TLM parameters.
- From then on, additions of services require renegotiation of ICD and technical agreements, and software development changes rather than simple system reconfiguration.

Overall view of the *components* of interoperability



Explanation of MOSSG recommendations on Service Interfaces

- CCSDS SM&C has done outstanding groundwork in establishing a framework for Mission Operations ***Systems*** interoperability
- SM&C experts are highly qualified on what underlying capabilities are required for systems interoperability, and the MO Services architecture reflects that.
- External entities (like MOSSG) may not fully understand the implications of how interoperable ***services*** will drive the agencies' underlying ***systems*** architecture.
- MOSSG grants to SM&C that the prescription of underlying system specifications issued so far are all probably necessary.
- We suggest, however, that now it's time to focus on a prescriptive Service Interface that allows more automated configuration and setup of interoperable end-to-end processes than SM&C currently provides.
- SM&C "next steps" should focus on techniques for lightweight, adaptable service interfaces by exploring current web services technologies (HTML5, RESTful interfaces, etc.).
- Generic guideline: ***Wherever possible***, the resulting service interfaces should decouple dependency on underlying systems architecture, so agencies can explore innovation in their internal systems architecture.

Systems and Processes relationships

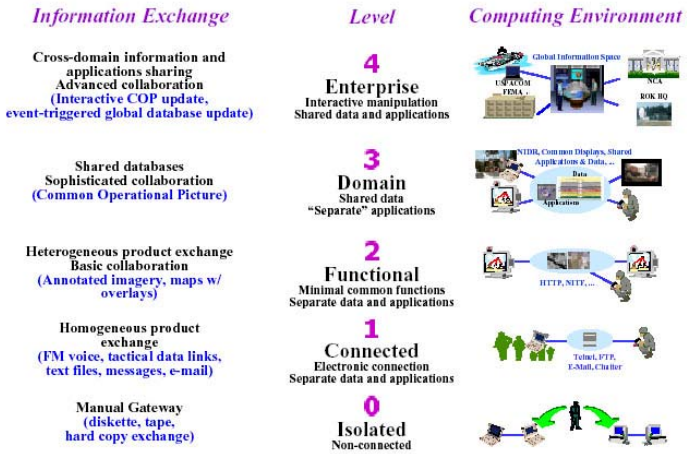
- The MOSCG findings were that Mission Operations processes in general, did not need to be addressed by the MOSSG.
  - Flight control procedures, training, planning processes, etc.
- The MOSSG was chartered to address only Mission Operations Systems for interoperability
  - Including systems for procedures, planning, training, etc.
- However, there is an overlap where MO processes must be addressed
  - Process for how component-level services are developed and configured end-to-end to meet MO process requirements
  - Component-level services are MAL, COM, Common Services, etc.
- Besides specifying component-level services, SM&C and MOSSG also need to address the processes for integrating them with the end-to-end processes for interoperability.
  - If SM&C has already started this, it's not apparent to the MOSSG or other external groups.

Conclusions

- CCSDS SM&C has done great work at establishing core capabilities for peer-to-peer Service Interfaces.
- The MOSSG concludes that more work is needed in the core standards to realize the “plug-n-play” vision.
- The MOSSG has also delivered “preliminary priorities” for future application-level services that run on the core MO Services capabilities established by SM&C.
- These preliminary priorities should be used cautiously because final priorities may change.
- However, SM&C sees fairly low risk in starting *some* application-level services and welcomes it if the resources don’t compete.
- If the resources do compete, CCSDS SM&C should consider whether Archive and File Management should be prioritized above the Planning BOF that is being organized at the next CCSDS meeting.

BACKUP

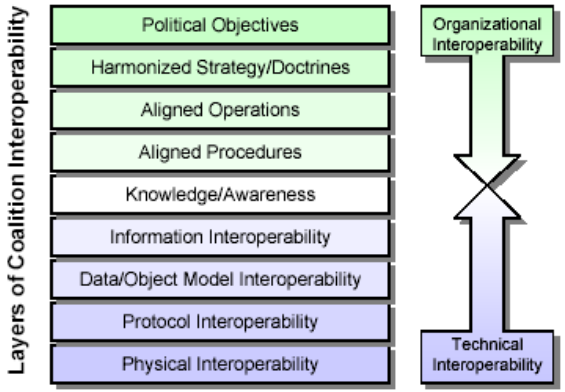
Various Interoperability Models (from SOSI rpt.)



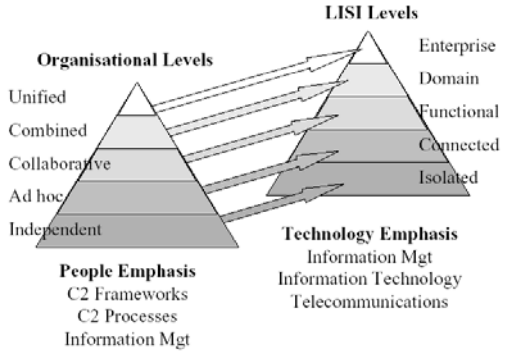
Levels of Information System Interoperability (LISI) Model

Level 0: independent
Level 1: ad hoc
Level 2: collaborative
Level 3: integrated
(also called combined)
Level 4: unified

Organizational Interoperability Maturity (OIM) Model *(Clark and Jones)*



Layers of Coalition Interoperability (LCI) Model *(Tolk)*



Alignment between Organizational model and LISI *(from SOSI)*

An MOSSG Simplified Interoperability Model